Generative Diffusion Prior for Unified Image Restoration and Enhancement

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Abstract

Existing image restoration methods mostly leverage the posterior distribution of natural images. However, they often assume known degradation and also require supervised training, which restricts their adaptation to complex real applications. In this work, we propose the Generative Diffusion Prior (GDP) to effectively model the posterior distributions in an unsupervised sampling manner. GDP utilizes a pre-train denoising diffusion generative model (DDPM) for solving linear inverse, non-linear, or blind problems. Specifically, GDP systematically explores a protocol of conditional guidance, which is verified more practical than the commonly used guidance way. Furthermore, GDP is strength at optimizing the parameters of degradation model during the denoising process, achieving blind image restoration. Besides, we devise hierarchical guidance and patch-based methods, enabling the GDP to generate images of arbitrary resolutions. Experimentally, we demonstrate GDP's versatility on several image datasets for linear problems, such as super-resolution, deblurring, inpainting, and colorization, as well as non-linear and blind issues, such as low-light enhancement and HDR image recovery. GDP outperforms the current leading unsupervised methods on the diverse benchmarks in reconstruction quality and perceptual quality. Moreover, GDP also generalizes well for natural images or synthesized images with arbitrary sizes from various tasks out of the distribution of the ImageNet training set. The project page is available at https://generativediffusionprior.github.io/